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Potato Gene Resources

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Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture

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The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture (SoWPGR-2) has recently become available by the Food and Agriculture Organization of the UN (2010) and provides a comprehensive overview of recent trends in Plant Genetic Resources for Food and Agriculture (PGRFA) conservation and use around the world. It is based on information gathered from more than 100 countries including Canada, as well as from regional and international research and support organizations and academic programmes. The report documents the current status of plant genetic resources diversity, conservation and use, as well as the extent and role of national, regional and international efforts that underpin the contributions of PGRFA to food security. It highlights the most significant technical and scientific advances that have occurred in the sector since 1996, when the first report on The State of the World's Plant Genetic Resources for Food and Agriculture was produced by FAO, as well as the gaps and needs that remain for setting future priorities and requiring urgent attention. The SoWPGR-2 provides the basis for updating the Global Plan of Action (GPA) for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture. Updating the GPA is taking place now and will likely be finalized in July 2011.

The SoWPGR-2 stresses the fact that PGRFA are even more important today than in the past in face of the demands on agriculture to produce more food of higher quality while preserving the natural resource base. The main messages from the SoWPGR-2 are:

- **PGRFA's are essential raw materials for helping farmers respond to climate change**
  Plant breeding capacity needs to be strengthened and breeding programmes must be expanded to develop varieties with traits needed to meet this challenge.

- **Loss of PGRFA has reduced options for the agricultural sector**
  The major causes of genetic erosion are land clearing, demographic pressures, overgrazing, environmental degradation and changing agricultural practices. Loss in genetic diversity within breeding

programs has been identified by Canada as an emerging issue.

- **Local PGRFA diversity found in farmers' fields or *in situ* is still largely inadequately documented and managed**
  There is now a growing awareness of the importance of this diversity and its contribution to local food security.

- **There has been progress in securing PGRFA diversity in a larger number of national gene banks**
  However, much of the diversity, particularly of crop wild relatives (CWR) and underused species relevant for food and agriculture, still needs to be secured for present and future use. Canada's national plant genetic resource system is ranked eighth largest in the world with major holdings of barley, oat and flax.

- **Rapid scientific advances, especially in information technology and molecular biology, have introduced new techniques for PGRFA conservation and use**
  Their wider application offers new opportunities to increase efficiency of the conservation–production chain.

- **Significant policy developments have changed the landscape of PGRFA management**
  Many more countries have adopted national programmes, laws and regulations for biodiversity following the adoption of the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The Global Crop Diversity Trust and the Svalbard Global Seed Vault are examples of initiatives to improve the *ex situ* conservation of PGRFA.

- **Better communication, collaboration and partnerships are needed among institutions dealing with PGRFA management – from conservation to plant breeding and seed systems**

These are the key factors for an integrated conservation and utilization strategy and delivering sustainable solutions to build a world without hunger.

Starch Granule Size Variation in Canadian Heritage Potato Varieties

Dr. Xiu-Qing Li, Mr. Jichong Zhang
Ms. Agnes Murphy and
Dr. Benoit Bizimungu
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Continued genetic improvement and novel product development of plants rely often on the use of genetic resources. The heritage potato varieties collected before the establishment of the official registration system in Canada are maintained at the Potato Gene Resources Repository, Agriculture and Agri-Food Canada, Fredericton.

Considering the importance of starch granule size in potato processing and potato food quality, we have recently measured the starch granules size in 14 heritage potato varieties: Angelina Mahoney's Blue, Bliss Triumph, Cherokee, Columbia Russet, Congo, Crotte d'Ours, Gold Coin, Green Mountain, Houma, Irish Cobbler, La Veine Rose/Belle Rose, Russet Burbank, Siberian and Up To Date.

The tubers used in this study were grown at the AAFC Benton Ridge potato breeding substation of the Potato Research Centre in 2008 and 2009. A large variation among the 14 heritage varieties has been observed for both starch granule size and shape. The largest single granule measured from 64 µm in 'Congo' to 90 µm in 'Russet Burbank' and 91 in 'Crotte d'Ours (Fig. 1).' The starch granule size variation among the varieties is very reproducible in terms of correlation between years, which means a strong genetic influence on the trait. The information provided by this starch granule size characterization can facilitate the

effective use of these heritage potato varieties.

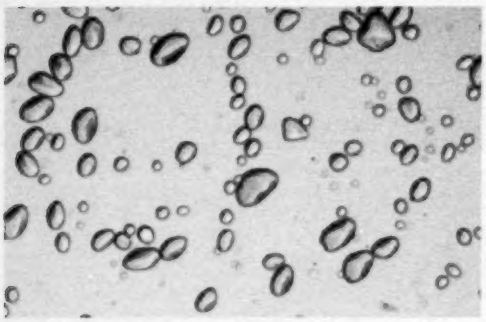

Figure 1. Starch granules of the variety Crotte d'Ours under a polarized microscope.

Unlocking Beneficial Genetic Diversity for the Canadian Environment

Dr. David De Koeyer, Research Scientist
Agriculture and Agri-Food Canada
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Beneficial traits for potato improvement are often found in wild species or landraces originating in tropical countries near the Equator. Most of these potatoes, when grown in Canada under long-day conditions, will not tuberize until very late in the growing season, if they tuberize at all. This "lateness" is a major limitation of the use of many potato resources that originate in the crop's centre of diversity, the Andean region of South America. Potato germplasm from Peru and other Latin American countries is the source of many important traits of interest for potato breeders (disease and pest resistance, enhanced nutrition, etc.); however, several breeding cycles across many decades may be required to incorporate this beneficial diversity into Canadian potato varieties adapted to long-day conditions. Scientists at the International Potato Center (CIP) in Lima, Peru have developed innovative breeding strategies to overcome this challenge.

Dr. David De Koeyer, a scientist at the Potato Research Centre in Fredericton is on a Research Branch Assignment at CIP to study photoperiod response. In collaboration with CIP scientists, he has initiated field and laboratory experiments to identify the genes in potato that are most critical in controlling the performance of potato varieties in environments with differing day lengths.

Field experiments were established using a panel of 136 clones from different CIP breeding populations, including control varieties that are known to have a day-neutral characteristic. The experimental material was grown in Lima, Peru under natural short-day conditions and in plots under artificial lights which were used to extend the natural day length to 16 hours (Figure 1). Photoperiod response was evaluated by monitoring tuberization in the field plots at 3 harvest dates throughout the growing season (Figure 2). The ability of each clone to tuberize was also monitored using stem-cuttings from the field plots (Figure 3). When an internal signal triggering tuberization is present in a plant, small tubers will form within two weeks. Data collected from these experiments will be combined with DNA marker and sequence data to help researchers identify critical genes for adaptation to contrasting environments.

Figure 1: Field plots at the International Potato Center in Lima, Peru with lights to extend day length.

CIP has one of the largest potato genetic resources collections in the world (http://www.cipotato.org/). The research conducted at CIP targets four regions: Latin America and the Caribbean; Sub-Saharan Africa; South, West, and Central Asia; and East and Southeast Asia and the Pacific. Therefore, the breeding program has targets in both tropical and temperate environments and developing germplasm with broad adaptation is an important goal. This AAFC-CIP collaborative research will lead to improved breeding strategies based on physiological and DNA marker selection and will help alleviate poverty in the developing world.

Figure 2a: Example of a clone that tuberized well under long-day conditions.

Figure 2b: Example of a clone that did not tuberize under long-day conditions.

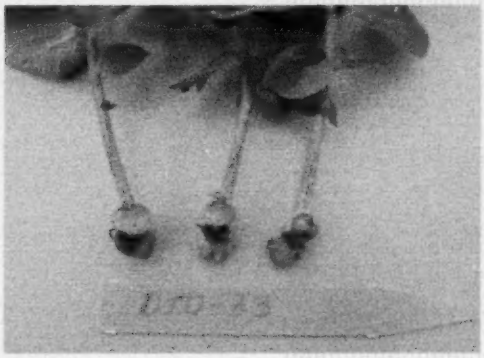

Figure 3a: Example of tuberization using stem-cutting assay.

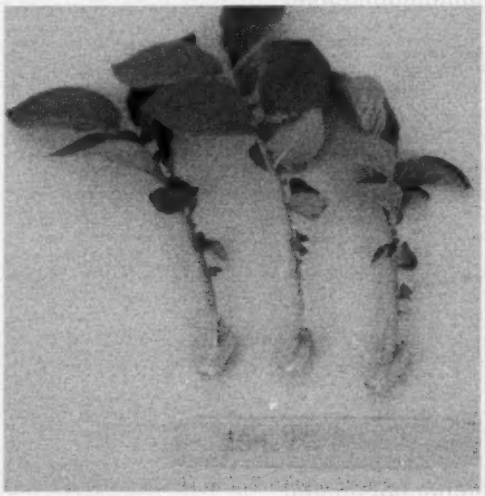

Figure 3b: Example of a non-tuberizing clone.

Update on the Potato Gene Resources Repository's New Lab

Dr. Benoît Bizimungu, Research Scientist
Potato Breeder and Germplasm Curator
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In the previous issue, we announced that funding had been approved for the renovation and development of a new laboratory space for the Potato Gene Resources Repository at the Potato Research Centre, and that construction works were about to start. The scope of this project

included the construction of a new secure room to house controlled environment cabinets (Growth Cabinet Room) as well as separate rooms for media preparation and sterile transfer (Media Preparation and Sterile Transfer Rooms) to support the work of the Potato Gene Resources Repository.

At this time, the majority of construction work is complete and final commissioning is underway to assure that all systems are operating and meet our expectations. The growth cabinets have been relocated to their new and secure location. We expect the new sterile transfer room and the media preparation room will be turned over for operation in the near future.

Previously, plant tissue research was conducted in a shared lab whereas the repository collection was maintained in controlled environment cabinets housed in common use areas. The facility is expected to meet international standards by providing adequate security of the germplasm in the repository as well as the required space to support the work in an efficient and secure manner.

The *in vitro* accessions are scheduled to increase over the next several years, therefore, efficiency is essential to the success of the Repository. They include modern Canadian-bred potato cultivars, heritage cultivars, selected breeding parents and many clones used in research, such as standards for evaluation testing and as indicators for disease pathotypes.

Change in the technical staff at the Potato Gene Resources Repository

Dr. Benoît Bizimungu, Research Scientist
Potato Breeder and Germplasm Curator
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We welcome Ms.Teresa Molen as the new Potato Gene Resources Repository Technician, in replacement of Ms. Jane Percy who retired from the Potato Research Centre in October of 2010.

Ms.Teresa Molen originally joined the Potato Research Centre in 2004 as a Plant Molecular Virology Technician after completion of a B.Sc. and M.Sc. in biology at the University of New Brunswick.

Ms. Molen will be handling requests and shipments of potato clones. She can be reached at the address below:

teresa.molen@agr.gc.ca

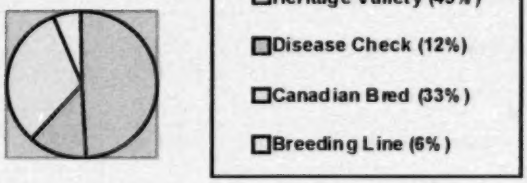
At the same time, we bid farewell to Ms.Trudy Dalton (Potato Breeding Technician) who retired from the Potato Research Centre in July of 2010. This vacancy was filled by Ms. Deborah Campbell/Smith who joined the Potato Research Centre in October 2009 as a temporary replacement for Jane Percy.

Annual Report 2010
Potato Gene Resources Repository

The Collection

1. Holdings

The Potato Gene Resources Repository contains 161 clones. Of this total, 159 are maintained *in vitro* and 2 as tubers. A full listing of accessions may be found on the attached request form. The following chart shows the percentage of clones in each Repository category.



2. New Accessions

Two new accessions have been added to the Repository in 2010. Makah was acquired from the Agricultural Certification Laboratory as *in vitro* plantlets. Katahdin was acquired from the New Brunswick Agriculture and Aquaculture Plant Propagation Centre. Other accessions; Dorita, Hindenburg, Abnaki, Manota, White Rural New Yorker, and Earlaine previously only available as tubers, have been introduced into *in vitro* form in 2010.

Evaluations of and descriptions for the new accessions will begin in 2011.

No accessions were lost from the inventory in 2010.

3. Evaluations

Seventeen varieties were grown in an evaluation trial at the Potato Research Centre. Two replications of fifteen hills of the following varieties All Red, Angelina Mahoney's Blue, Banana, Candy Cane, Cariboo, Chieftain, Crotte d'Ours, Dorita, Garnet Chili, Haida, Libertas, Lumpers, Marc Warshaw's Quebec, Mouraska, Red Warba, Superior, Urgenta, White Rose, Yellow Finn were grown. Chieftain and Superior were grown as checks. The tubers and tuber light sprouts were photographed by Cynthia Murray. Samples were also taken for Total Glycoalkaloid Analysis (TGA).

Twenty-one clones were grown in 20 hill plots at the Benton Ridge Potato Breeding Substation, Benton, NB, to provide material for demonstration and cooking quality evaluation throughout the winter and spring.

4. Documentation

Passport data for all PGR accessions has been added to the Genetic Resources Information Network-Canadian Version (GRIN-CA). GRIN-CA may be accessed through the Plant Gene Resources of Canada web site http://pgrc3.agr.ca/.

Disease testing of new *in vitro* accessions and clones which have been maintained *in vitro* for five years was completed. Twenty two clones were grown in the greenhouse and tested twice in 2010. All clones were negative for PVA, PLTV, PotLV, PVS, PVX and PVY. Results for PSTV and BRR are pending. Extra mini tubers from the greenhouse grow out will be offered to PGR clients in the spring 2011.
In vitro clones were screened for bacterial and fungal contamination using Potato Dextrose Broth and Richardson's broth, twice during 2010. All clones currently in the Repository were negative for these contaminants.

A total of 2043 micro tubers were produced from 123 of the PGR clones in 2010. They were harvested in August, and will be sent to Saskatoon to be stored at Plant Gene Resources of Canada, AAFC. The viability of the Repository is protected by this remote

location, long-term storage arrangement. Dallas Kessler of Plant Gene Resources Canada, Saskatoon SK, continues to monitor and evaluate the micro tubers.

5. Distribution

Nineteen requests for 466 clones were received in 2010. Of this number, 171 clones were distributed *in vitro*, 216 clones as field grown tubers, and 79 clones as greenhouse grown minitubers.

Purpose of request	Number of clients requesting	Clones	*In vitro*	Tubers	Mini tubers
Research	12	255	103	114	38
Teaching/demonstration	2	81	27	39	15
Conservation	5	130	41	63	26
Totals	19	466	171	216	79

Number of 2010 Requests by Destination

Destination	Number of Requests
Newfoundland and Labrador	2
Prince Edward Island	1
Nova Scotia	1
New Brunswick	1
Quebec	3
Ontario	4
Saskatchewan	2
Alberta	2
USA	3
Total	19

Five Year Compilation of Clone Distribution for Potato Gene Resources 2006-2010

Year	Total	Research	Teaching/ demonstration	Total	Clones distributed as mini tuters & tubers	Clones distributed *in vitro*	Clones distributed as micro tubers
2006	45	12	33	511	297	214	0
2007	49	15	34	552	220	210	122
2008	48	9	39	555	345	210	0
2009	57	9	48	655	311	203	141
2010	19	4	15	466	295	171	0
5-year total	218	52	167	2738	1468	1008	263

• Kroop Neber was the most requested clone in 2010. It was followed closely by Raritan, Ratte, Stella's Newfoundland, and Columbia Russet.

Repository Items of Interest

Communication

The annual Potato Gene Resources newsletter has a distribution of 375.

This newsletter and several back issues may be accessed on the Weekly Checklist of Government of Canada Publications. Browse for the newsletter by title at:
http://publications.gc.ca/

Photos of many of the accessions in the Repository are now available to view on the GRIN-CA site. Search on clone names at http://pgrc3.agr.ca/acc/search-recherche_e.html

Many thanks to Eugene Timmermans, Plant Gene Resources of Canada for making this possible.

Displays

Potato clones from the Repository and National Potato Breeding Program were featured at the 2010 Potato Grower's Days in Woodstock NB, and at the Benton Substation open house.

Dr. Benoit Bizimungu had a Potato Gene Resources display at the Apple Bin in Keswick Ridge, NB as a part of New Brunswick's Open Farm Day in September.

AAFC-AAC had a research exhibit at a student day held in October at the Canadian Forestry Centre in Fredericton, NB. The event titled Science at the Centre was part of Science and Technology week celebrations. The Potato Gene Resources material was used to support the biodiversity part of the display.

An AAFC exhibit featuring posters and material from the Potato Gene Resources Repository was featured at the Seeds of Diversity Canada annual meeting held in Fredericton, NB in October.

Visitors

In September, the Deputy Minister of Agriculture, Mr. John Knubley, visited the Potato Research Centre. Potato Gene Resources Repository material was among the many displays presented to him during his visit.

The New Brunswick Institute of Agrologists held their 50th Anniversary festivities at the Potato Research Centre in September. Potato Gene Resources Material was part of a display for the group as they toured the laboratory facilities at the Centre.

Ms. Frédérique Aurousseau, Potato Breeder, station De Recherche Du Comite Nord, Bretteville du grand Caux, France visited the Potato Research Centre from September 12 to October 1, 2010. She is collaborating with PRC scientists in a joint project to develop improved potato cultivars with resistance to Colorado potato beetle. She visited the Potato Gene Resources Repository while in Fredericton.

Dr. Ramona Thieme, of the Federal Research Centre for Cultivated Plants in Germany, spent two weeks in late September at the Potato Research Centre in Fredericton. Her research interests include potato germplasm enhancement using wild species.

Seeds of Diversity of Canada board members, executive director, and office administrator visited the new Repository facilities at the AAFC Fredericton Centre while in Fredericton for that organization's annual meeting.

Christian Fortin, Team Lead, Sustainable Production East; and Benoit Rancourt, Commercialization Officer from Saint-Jean-sur-Richelieu, Quebec of the Office of Intellectual Property and Commercialization, AAFC, visited the new Repository facilities in November.

Potato Gene Resources Newsletter

The Potato Gene Resources Newsletter is an annual publication of the Potato Gene Resources Repository, Potato Research Centre, Agriculture and Agri-Food Canada.

The Newsletter provides information on potato germplasm in the Repository and on issues related to the genetic diversity in the potato. The opinions expressed by authors may not necessarily represent the views of Agriculture and Agri-Food Canada.

The Repository and the Seed Potato System

The Potato Gene Resources Repository provides *in vitro* plantlets and greenhouse or field tubers for breeding, research and heritage preservation. While extensively tested for freedom from disease, the plantlets and tubers distributed by the Potato Gene Resources Repository are produced outside the Canadian Seed Certification System and are not eligible for Certification.

The Canadian Seed Potato Certification System operates under the Seed Act and its Regulations. Certification begins with tested plantlets established *in vitro* in a facility accredited for this task by the Canadian Food Inspection Agency. The plantlets are used to produce greenhouse tubers which then go to the field in a limited generation system, at each step meeting strict standards specified in the Regulations. The Potato Gene Resources Repository is not accredited for seed production by the CFIA.

Potato Research Centre Website

http://www.agr.gc.ca/researchcentre/fredericton offers an overview of the mandate, resources and achievements of the Centre. The research studies being conducted at the Centre as well as the staff associated with those studies is highlighted. Links to the Potato Research Network and to other agriculture and potato related websites are also available.

Plant Gene Resources of Canada

Canada's Plant Germplasm System is a network of Centres and people dedicated to preserving the genetic diversity of crop plants, their wild relatives and plants present are unique in the Canadian biodiversity system. The system plays a significant part of Agriculture and Agri-food Canada's commitment to the Canadian Biodiversity Strategy in response to the Convention on Biological Diversity.

The Plant Gene Resources of Canada (PGRC) website located at http://pgrc3.agr.ca/ includes information on the PGRC and the multi-nodal system of germplasm conservation in Canada as well as opportunities to search for germplasm on the Genetic Resources Information Network-Canadian version (GRIN-CA). Dr. Ken Richards, Research Manager, Plant Gene Resources of Canada, may be contacted at Ken.Richards@agr.gc.ca.

Personnel of the Potato Gene Resources Repository and Potato Breeding Program Potato Research Centre

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Agnes Murphy – Plant Pathologist
Teresa Molen – Potato Gene Resources Technician
Susan Hatt – Potato Gene Resources Technician
Deborah Smith – Potato Breeding Technician
Trudy Dalton – Potato Breeding Technician
Donna Wilson – Plant Pathology Technician
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